
SUPPORT TO PRIVATE SECTOR TELECOMMUNICATIONS ACTIVITIES:

Cooperative Research with Industry

Outputs

- PC software (VQM) that objectively measures video quality made available on the Internet for evaluation.
- Mobile, broadband measurements of propagation in urban and suburban environments made available to Lucent Bell Laboratories for research into the performance of multiple input multiple output (MIMO) antenna systems.

The Federal Technology Transfer Act of 1986 (FTTA), as amended, allows Federal laboratories to enter into cooperative research agreements with private industry, universities, and other interested parties. The law was passed in order to provide laboratories with clear legal authority to enter into these arrangements and thus encourage technology transfer from Federal laboratories to the private sector. Under this Act, a cooperative research and development agreement (CRADA) can be implemented that protects proprietary information, grants patent rights, and provides for user licenses to corporations, while allowing Government expertise and facilities to be applied to interests in the private sector.

ITS participates in technology transfer and commercialization efforts by fostering cooperative telecommunications research with industry where benefits can directly facilitate U.S. competitiveness and market opportunities. ITS has participated for a number of years in CRADAs with private sector organizations to design, develop, test, and evaluate advanced telecommunication concepts. Research has been conducted under agreements with:

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| • American Automobile Manufacturers Association | • FirstRF Corporation |
| • ARINC | • General Electric Company |
| • AudioLogic, Inc. | • GTE Laboratories Inc. |
| • Bell South Enterprises | • Hewlett-Packard Company (HP) |
| • Bell Atlantic Mobile Systems | • Integrator Corporation |
| • East Carolina University's Brody School of Medicine | • Intel Corporation |

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| • Lehman Chambers | • Telesis Technology Laboratories |
| • Lucent Digital Radio | • University of Colorado |
| • Lucent Technologies | • University of Pennsylvania |
| • Motorola/Freescale Inc. | • US WEST Advanced Technologies |
| • Netrix Corporation | • US WEST New Vector Group |
| • RF Metrics | |
| • Savi Technologies | |
| • Spectrum Mapping LLC | |

Not only does the private sector partner benefit, but the Institute is able to undertake research in commercially important areas that it would not otherwise be able to do. Active CRADAs in FY 2004 are described below.

Lucent Technologies, Bell Laboratories, and ITS completed cooperative research to evaluate the performance of multiple input multiple output (MIMO) antenna systems for mobile wireless communications. MIMO technology promises to greatly increase spectrum capacity for wireless services including high data rate mobile services.

Motorola/Freescale, Inc., and ITS made measurements to determine the potential for interference from several ultrawideband (UWB) and other signals to existing spectrum users. Two of the UWB signals studied were being considered for the IEEE standard for Personal Area Networks. The results of this work were important inputs to the IEEE standard and the FCC's rulemaking regarding UWB.

Savi Technologies and ITS measured the mutual effects between an RF identification (RFID) system and FM amateur radio equipment in the 400-MHz band.

In FY 2004, ITS received 172 new requests for copies of ITS' Video Quality Metric (VQM) software for evaluation purposes. This software objectively measures video quality as it would be perceived by end-users of a video system. ITS's VQM, already a national standard (ANSI), was made an international standard by the International Telecommunication Union. Commercial licensing of the VQM technology is available with reasonable



ITS and Savi Technologies staff at the Table Mountain field site, preparing to measure the mutual effects between an RFID and FM amateur radio equipment in the 400-MHz band (photograph by F.H. Sanders).

and equitable terms. Two new VQM commercial licenses were issued last year.

In FY 2004, ITS had 140 active accounts with the private sector for use of its Telecommunications Analysis Services (TA Services). TA Services consists of a number of wireless databases and propagation models that can be used on a reimbursable basis.

Cooperative research with private industry has helped ITS accomplish its mission to support industry's productivity and competitiveness by providing insight into industry needs. This has led to adjustments in the focus and direction of other Institute programs to improve their effectiveness and value.

ITS is interested in assisting private industry in all areas of telecommunications. The pages of this technical progress report reveal many technological

capabilities that may be of value to various private sector organizations. Such organizations are encouraged to contact ITS if they believe that ITS may have technology useful to them. Because of the great commercial importance of many new and emerging telecommunication technologies, including third generation wireless (3G), wireless local area networks, digital broadcasting, and intelligent transportation systems, ITS plans to vigorously pursue technology transfer to the private sector through CRADAs and thereby contribute to the rapid commercialization of these new technologies. ITS also plans to commit substantial laboratory resources to the development and standardization of new telecommunication technologies.

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SUPPORT TO PRIVATE SECTOR TELECOMMUNICATIONS ACTIVITIES:

ITU-R Standards Activities

Outputs

- Technical support to the U.S. Administration in Working Party 8B, the Radar Correspondence Group, and Joint Rapporteurs Group 1A-1C-8B, and also in Study Group 3.
- Measurements performed to determine responsiveness of prototype dynamic frequency selection (DFS) devices to radar emissions at 5 GHz.
- Tests and measurements performed on effects of interference from communication system signals into a long-range air search radar.
- Joint ITS-OSM presentation on future X-band (9300-9500 MHz) radar development, given at a meeting of Study Group 8 in Geneva.
- Joint measurements between ITS, OSM, and the Administration of Japan on emission spectra of S-band and X-band maritime radars.

Success in worldwide telecommunication markets, as well as successful, compatible use of telecommunications technologies, is critical to the long-term success of the United States in many spheres. To achieve these goals, the U.S. Administration participates in a telecommunications standards and regulatory body, the International Telecommunication Union — Radiocommunication Sector (ITU-R), to further its objectives regarding all forms of wireless communication on a worldwide basis. ITS provides important, ongoing technical support for the U.S. Administration in ITU-R Study Groups 3 and 8 (see pp. 40-41); Working Party 8B; the Radar Correspondence Group (RCG), and Joint Rapporteur Group (JRG) 1A-1C-8B. Current areas of interest include (but are not limited to): dynamic frequency selection technology proposed for 5 GHz spectrum sharing between communication systems and radars; radar emission spectrum measurement techniques; effects on radars of interference from communication systems; and development of new X-band radar technologies.

A number of proposals have been made by non-U.S. Administrations to introduce communication systems into bands heretofore allocated for radars on

a primary basis. Since the U.S. Administration has made an enormous investment in the development and deployment of military and civilian radars, it is essential that new systems proposed for spectrum sharing be shown to be electromagnetically compatible with existing and future radars. To this end, ITS engineers in FY 2004 tested the new technology, called dynamic frequency selection (DFS), for the U.S. Administration. The tests were conducted jointly by ITS, NTIA's Office of Spectrum Management (OSM), and industry. The DFS prototypes under test used RLAN technology to communicate in 5 GHz spectrum used by radars. The sharing technique requires that the DFS devices must sense radar signals and then vacate frequencies used by radars. The tests at ITS determined the extent to which prototype DFS devices accomplished this goal.

Other proposed techniques for sharing spectrum between radars and communication systems require that radar receivers sometimes operate co-channel with potentially interfering communication signals. Unfortunately, very little information has ever been gathered on the effects of interference from communication signals in radar receivers. ITS and OSM have worked together for several years to learn about these effects. As part of this effort, interference tests and measurements were performed by ITS and OSM engineers in FY 2004 on a long-range air surveillance radar at a joint FAA-NORAD site. In the course of the tests, interference signals were injected into the radar receiver while targets were observed. The effects on target detection were observed at a variety of interference levels. Targets were artificially generated for some tests, and were 'live' aircraft in other tests. The radar receiver was found to be highly sensitive and susceptible to such interference at rather low levels. The test results have been used for U.S. Contributions in WP-8B.

Additional work in ITU-R has been devoted to chairmanship of the Radar Correspondence Group by an ITS engineer, as well as ongoing support and written Contributions for JRG 1A-1C-8B on the topic of future development of radar technology in the X band (9300-9500 MHz).

ITS, OSM, and Japanese Administration engineers used a Draft New Recommendation (M.1177),



Figure 1. Set-up for a joint US-Japan maritime radar emission spectrum measurement at the ITS Table Mountain facility near Boulder. The measurements were performed using new ITU Recommendation techniques primarily authored by an ITS engineer (photo by F.H. Sanders).



Figure 2. A meeting of Working Party 8B in Geneva in 2004. Critical US Administration spectrum interests are routinely supported by ITS engineers at this and other ITU meetings (photo by F.H. Sanders).

primarily authored by an ITS engineer, to perform measurements on emissions on five maritime S-band and X-band radars. The measurements were performed at the Table Mountain facility north of Boulder (see Figure 1 above). Results will be used in future Contributions to WP-8B by both the US and Japanese Administrations (see Figure 2).

Recent Publications

F. Sanders, R. Hinkle, and B. Ramsey, "Measurement Procedures for the Radar Spectrum Engineering Criteria (RSEC)," NTIA Report 05-XX, in progress.

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ITU-T & Related U.S. Standards Development

Outputs

- Leadership of ITU-T and related U.S. telecommunications standards committees.
- Technical contributions presenting U.S. standards proposals and ITS research results.
- Proposed ITU Recommendations and associated U.S. industry standards.

The Institute has a long and distinguished history of leadership, technical contributions, and advocacy of U.S. Government and industry proposals in international and related national telecommunication standards committees. These activities are focused in the International Telecommunication Union (ITU) — the United Nations-affiliated standards organization responsible for the cooperative planning and interoperation of public telecommunication systems and services worldwide. The ITU's Telecommunication Standardization Sector (ITU-T) develops international standards (Recommendations) addressing technical, operating, and tariff questions relating to all aspects of wireline telecommunications. ITU-T Recommendations have a strong impact on both the evolution of U.S. telecommunications infrastructures and the competitiveness of U.S. telecommunications products in international trade.

ITS has played a strong role in ITU-T standardization work for many years. The Institute's long-term goal there (and in related national standards work) is to motivate standardization of user-oriented, technology-independent, end-to-end measures of telecommunication Quality of Service (QoS) — and to relate those end-to-end measures with the technology-specific performance metrics service providers use to provision and operate their networks. This standardization activity promotes fair competition and technology innovation among equipment and service providers, facilitates interworking among independently-operated networks and dissimilar technologies, and gives users a quantitative, practical means of defining their telecommunication requirements and selecting products and services that meet them.

In FY 2004, the Institute provided leadership in two key ITU-T groups: Study Group 13 Working Party 4 (Network Performance and Resource Management) and Study Group 9's Working Group on Quality Assessment. Study Group 13 develops international standards (Recommendations) addressing Optical Transport Network (OTN), Multi-Protocol Label Switching (MPLS), Ethernet, and IP-based technologies, all of which are expected to play an important role in the realization of multi-service Next-Generation Networks (NGNs). SG 13/WP 4 develops international standards on network performance and resource management for all of the NGN core technologies. SG 9's Working Group on Quality Assessment defines quality objectives for integrated broadband cable networks and television and sound transmission. Within that group ITS chairs Question 21/9, "Objective and Subjective Methods for Evaluating Audiovisual Quality in Multimedia Services." ITS also provides leadership and technical contributions in the ITU affiliated Video Quality Experts Group (VQEG) and the Alliance for Telecommunications Industry Solutions (ATIS) Network Performance, Reliability and Quality of Service Committee (PRQC), formerly T1A1. VQEG works in conjunction with ITU-T SGs 9 and 12 and ITU-R WP6Q (Broadcasting Services — Performance Assessment and Quality Control) to develop objective, computer implementable, perception-based video quality metrics (VQMs) that emulate the human visual system. PRQC develops national standards and contributes strongly to ITU-T in all of these technology areas.

During FY 2004, the Institute's SG 13 leadership contributed to the completion and approval of eight ITU-T Recommendations, providing new specifications on OTN performance, IP network traffic and congestion control, MPLS network performance, IP network call processing, and other topics of importance to NGN. ITS presented key results of this work in an ITU-T workshop session, "Specification and Signaling of IP QoS Classes," summarized at <http://www.itu.int/ITU-T/worksem/qos/program.html>. ITS also provided technical leadership supporting U.S. Government and industry preparation for the World Telecommunication Standardization Assembly (WTSA), a quadrennial meeting at which the ITU-T Member States determine the objectives, structure, work methods, and senior leadership of ITU-T for the following 4-year Study Period. ITS participated in the formation and technical

management of the ITU-T NGN Focus Group, a transitional standards organization established by the ITU-T Director to accelerate NGN standardization work during the “interregnum” period surrounding the WTSA. As input to the WTSA, ITS developed a summary Recommendation that concisely defines the scope, application, and interrelationships among the over 30 performance Recommendations developed by SG 13/WP 4. The Institute also contributed strongly to the development of a key U.S. Government contribution to WTSA, proposing the creation of a new NGN Study Group for the 2005-2008 Study Period. Industry leaders believe NGN standardization will be very important in defining new network technologies capable of fully integrating today’s wired telephony, video, wireless, and Internet infrastructures and services — and motivating the capital investment needed to deploy them.

ITS leadership in PRQC contributed to the completion and approval of five new ATIS specifications on network reliability performance and emergency telecommunications service (ETS), two new ATIS specifications on video communication quality, and numerous U.S. contributions to ITU-T on related topics. The new ATIS specifications address U.S. industry needs and advance key goals of both the DoC and the Department of Homeland Security. The Institute’s technical contributions to PRQC included contributions on QoS specification, QoS interoperability, and IP network QoS signaling. One contribution of particular import identified interoperability issues and evaluated possible mapping solutions for QoS interworking between wireless and wireline IP networks. ITS participated with other leaders in implementing a major reorganization of the ATIS standards committees, contributing to a more product-driven ATIS standards management regime and elevating the former Committee T1 Technical Subcommittees to independent standards development organizations. ITS helped shape the technical objectives for a newly-formed ATIS NGN Focus Group, promoting coordination of U.S. NGN standardization efforts with ongoing ITU-T work.

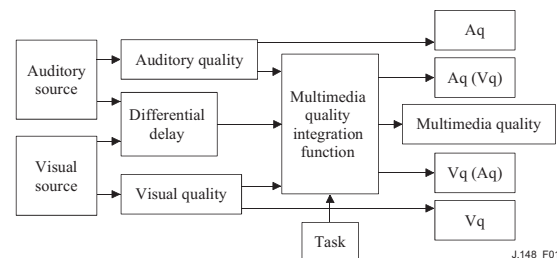
ITS has co-chaired the ITU Video Quality Experts Group since its formation in 1997. VQEG enables video experts from many countries to collaborate in developing and evaluating video quality metrics, and its results strongly impact the standardization of VQMs in both ITU-T and ITU-R. The group works primarily via an e-mail reflector, publicly accessible at <http://www.VQEG.org>. During FY 2004 the number of participants subscribed to this reflector grew

to 380. ITS chaired two physical meetings and several conference call meetings in FY 2004.

During FY 2004, ITU-T and ITU-R approved several Recommendations based on work supported by ITS. Most noteworthy are ITU-T Recommendation J.149, “Methodological Framework for Specifying Accuracy and Cross-Calibration of Video Quality Metrics (VQM),” and ITU-T Recommendation J.144 Revised, “Objective Perceptual Video Quality Measurement Techniques for Digital Cable Television in the Presence of a Full Reference.”

J.144 Revised was the result of a multi-year VQEG effort to evaluate “full reference” VQMs for assessing standard definition television. During FY 2004, VQEG undertook a complementary “reduced reference” validation test for standard definition television, to be completed in FY 2005. VQEG also launched a major new initiative in the area of multimedia quality assessment. ITS leadership was instrumental in forming the Joint Rapporteur Group on Multimedia Quality Assessment (JRG-MMQA), a cross-cutting ITU-T standards body that will unite the video quality expertise of SG 9 with the audio quality expertise of SG 12 in a cooperative effort to develop objective, perception-based metrics for combined audio and video in mobile and PC environments. This group is co-chaired by ITS.

The figure below (from Recommendation J.148) illustrates the basic components of a multimedia quality assessment model.



Basic components of a multimedia quality assessment model.

Recent Publication

A. Webster, Ed., “ITU-T Tutorial on Objective Perceptual Assessment of Video Quality: Full Reference Television,” 2004.

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